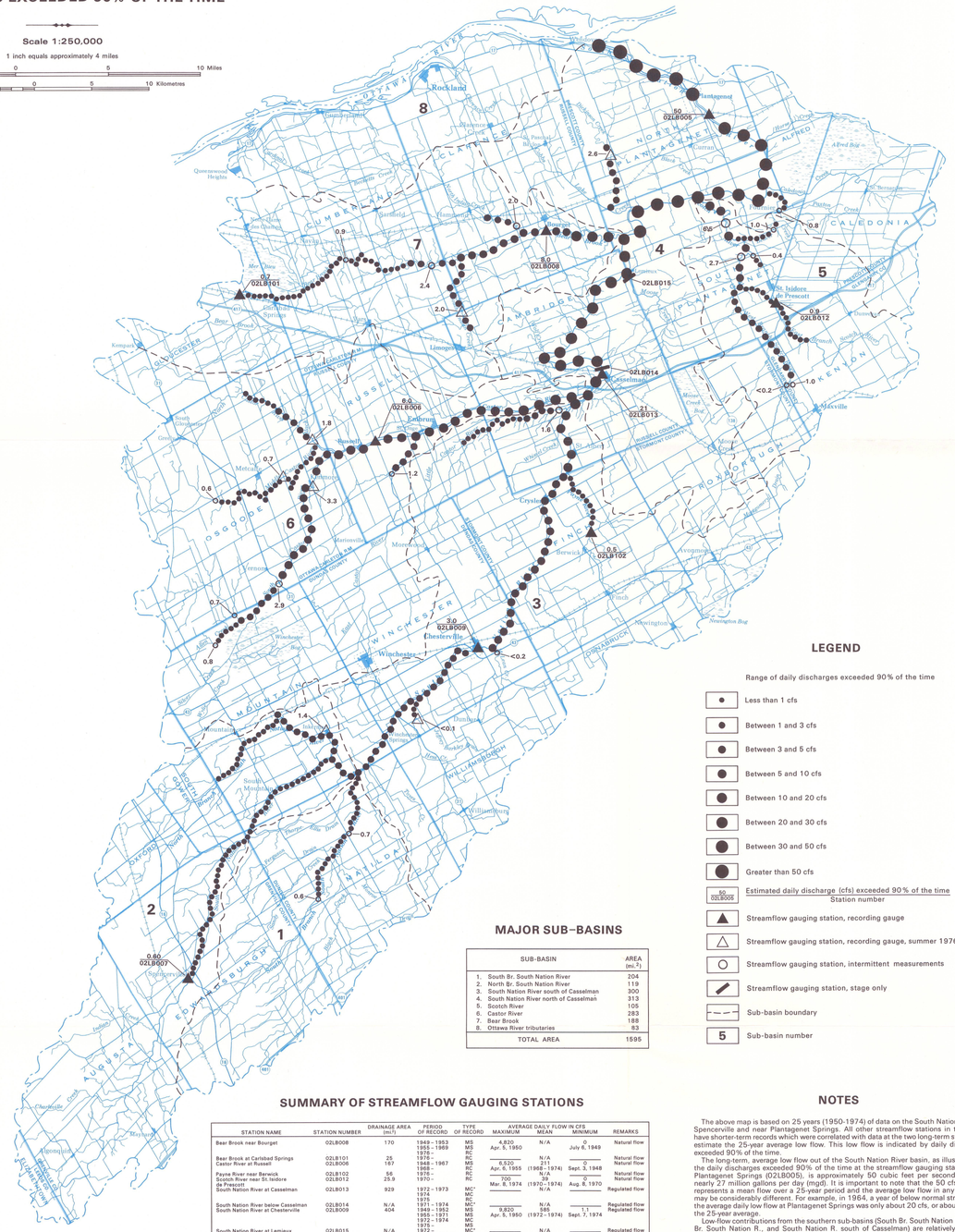
LOW FLOWS AS INDICATED BY DAILY DISCHARGES EXCEEDED 90% OF THE TIME

Scale 1:250,000

1 inch equals approximately 4 miles

5 0 5 10 Miles

5 0 5 10 Kilometres



LEGEND

Range of daily discharges exceeded 90% of the time

- Less than 1 cfs
- Between 1 and 3 cfs
- Between 3 and 5 cfs
- Between 5 and 10 cfs
- Between 10 and 20 cfs
- Between 20 and 30 cfs
- Between 30 and 50 cfs
- Greater than 50 cfs
- 50 / 02LB005 — Estimated daily discharge (cfs) exceeded 90% of the time / Station number
- Streamflow gauging station, recording gauge
- Streamflow gauging station, recording gauge, summer 1976
- Streamflow gauging station, intermittent measurements
- Streamflow gauging station, stage only
- Sub-basin boundary
- 5 — Sub-basin number

MAJOR SUB-BASINS

SUB-BASIN	AREA (mi.²)
1. South Br. South Nation River	204
2. North Br. South Nation River	119
3. South Nation River south of Casselman	300
4. South Nation River north of Casselman	313
5. Scotch River	105
6. Castor River	283
7. Bear Brook	188
8. Ottawa River tributaries	83
TOTAL AREA	1595

SUMMARY OF STREAMFLOW GAUGING STATIONS

STATION NAME	STATION NUMBER	DRAINAGE AREA (mi.²)	PERIOD OF RECORD	TYPE OF RECORD	AVERAGE DAILY FLOW IN CFS MAXIMUM	MEAN	MINIMUM	REMARKS
Bear Brook near Bourget	02LB008	170	1949–1953 1955–1989	MS MS	4,820 Apr. 5, 1950	N/A	0 July 6, 1949	Natural flow
Bear Brook at Carlsbad Springs	02LB101	25	1976–	RC				Natural flow
Castor River at Russell	02LB006	167	1948–1967 1976–	MS RC	5,530 Apr. 6, 1955	N/A 311 (1968–1974)	0 Sept. 3, 1948	Natural flow
Payne River near Berwick	02LB102	56	1976–	RC		N/A		Natural flow
Scotch River near St. Isidore de Prescott	02LB012	25.9	1970–	RC	700 Mar. 8, 1974	39 (1970–1974)	0 Aug. 8, 1970	Natural flow
South Nation River at Casselman	02LB013	929	1972–1973 1974 1975	MC MS RC		N/A		Regulated flow
South Nation River below Casselman	02LB014	N/A	1971–1974	MC*		N/A		Regulated flow
South Nation River at Chesterville	02LB009	404	1949–1952 1955–1971 1973–1974 1975–	MS MS MS MC*	9,820 Apr. 5, 1950	585 (1972–1974)	1.1 Sept. 7, 1974	Regulated flow Regulated flow
South Nation River at Lemieux	02LB015	N/A	1972–	MC*		N/A		Regulated flow
South Nation River near Plantagenet Springs	02LB005	1470	1915–1938 1939–1947 1948–1962 1963–	MS MS MS RC	42,100 Apr. 2, 1951	1,392 (1950–1974)	10 Oct. 3, 1957	Regulated flow Regulated flow
South Nation River at Spencerville	02LB007	95	1948 1949–1959 1960–	MS MC RC	3,590 Apr. 6, 1950	105 (1950–1974)	0 Aug. 8, 1956	Regulated flow

Explanation: M – Manual gauge; R – Recording gauge; C – Continuous operation; S – Seasonal operation; * – Stage only; N/A – Not available

NOTES

The above map is based on 25 years (1950-1974) of data on the South Nation River at Spencerville and near Plantagenet Springs. All other streamflow stations in the basin have shorter-term records which were correlated with data at the two long-term stations to estimate the 25-year average low flow. This low flow is indicated by daily discharges exceeded 90% of the time.

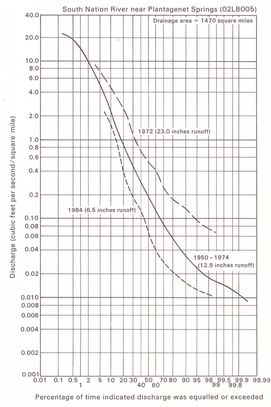
The long-term, average low flow out of the South Nation River basin, as illustrated by the daily discharges exceeded 90% of the time at the streamflow gauging station near Plantagenet Springs (02LB005), is approximately 50 cubic feet per second (cfs), or nearly 27 million gallons per day (mgd). It is important to note that the 50 cfs average represents a mean flow over a 25-year period and the average low flow in any one year may be considerably different. For example, in 1964, a year of below normal streamflow, the average daily low flow at Plantagenet Springs was only about 20 cfs, or about 40% of the 25-year average.

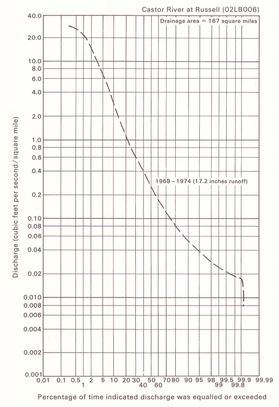
Low-flow contributions from the southern sub-basins (South Br. South Nation R., North Br. South Nation R., and South Nation R. south of Casselman) are relatively small in comparison to contributions from the northern sub-basins (South Nation R. north of Casselman, Scotch R., Castor R., and Bear Brook). About 10 cfs is contributed by the southern sub-basins and 40 cfs by the northern sub-basins. The contribution of low flows from the southern sub-basins is attributed generally to the absence of large areas of permeable surficial materials that are usually associated with good perennial flows.

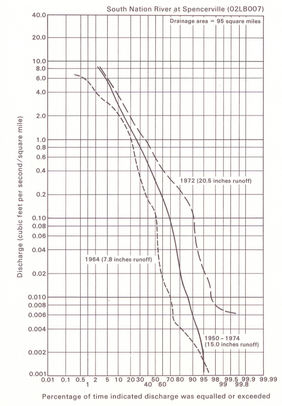
In comparison to most southern Ontario basins, the low flow out of the South Nation River basin, on a per square mile basis, is relatively small.

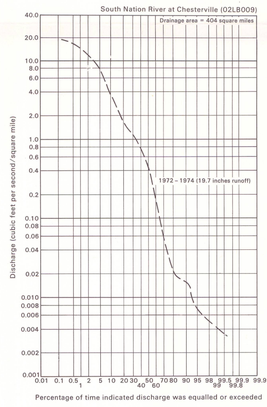
MAP 2205

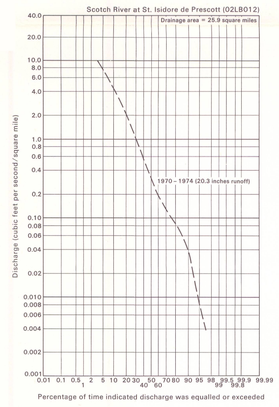
DAILY-FLOW DURATION CURVES


South Nation River near Plantagenet Springs (02LB005)
Drainage area = 1470 square miles
1972 (23.0 inches runoff)
1964 (6.5 inches runoff)
1950 – 1974 (12.9 inches runoff)
Discharge (cubic feet per second / square mile)
Percentage of time indicated discharge was equalled or exceeded


Castor River at Russell (02LB006)
Drainage area = 167 square miles
1968 – 1974 (17.2 inches runoff)
Discharge (cubic feet per second / square mile)
Percentage of time indicated discharge was equalled or exceeded


South Nation River at Spencerville (02LB007)
Drainage area = 95 square miles
1972 (20.5 inches runoff)
1964 (7.8 inches runoff)
1950 – 1974 (15.0 inches runoff)
Discharge (cubic feet per second / square mile)
Percentage of time indicated discharge was equalled or exceeded


South Nation River at Chesterville (02LB009)
Drainage area = 404 square miles
1972 – 1974 (19.7 inches runoff)
Discharge (cubic feet per second / square mile)
Percentage of time indicated discharge was equalled or exceeded

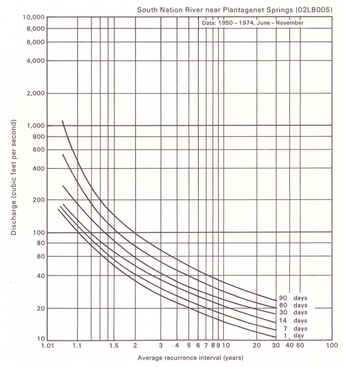

Scotch River at St. Isidore de Prescott (02LB012)
Drainage area = 25.9 square miles
1970 – 1974 (20.3 inches runoff)
Discharge (cubic feet per second / square mile)
Percentage of time indicated discharge was equalled or exceeded

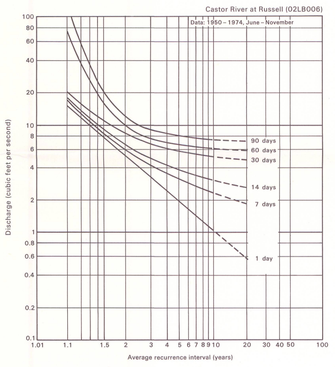
NOTES

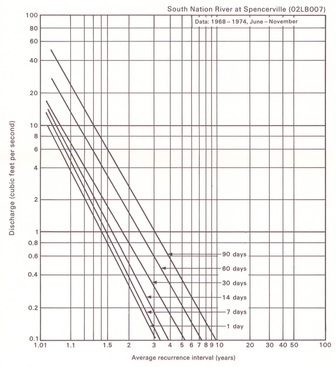
Flow-duration curves show the percentage of time that specified discharges were equalled or exceeded during the period from January to December. These curves show the combined effects of the various factors that affect streamflows – climate, topography, and geology.

The above curves show generally steep slopes in both the high and low-flow ends, indicating a lack of surface storage to limit high flows and low ground-water discharges to maintain baseflows. Streamflows at Spencerville and St. Isidore de Prescott have often been zero.

ANNUAL MINIMUM DAILY DISCHARGES



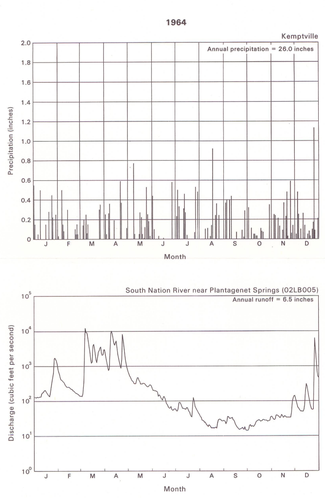


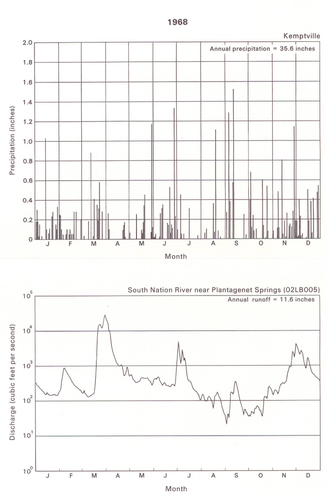


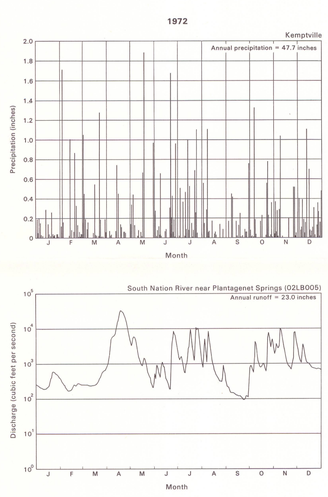
NOTES

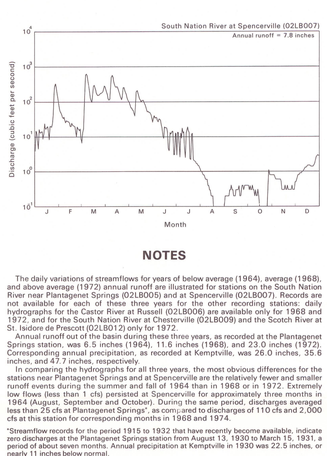
Frequency curves of annual minimum daily discharges show the average recurrence intervals for specified discharges for durations ranging from 1 to 90 consecutive days. Curves with steep slopes in the lower ends indicate that there are large variations between minimum flows in different years. This is especially evident at Spencerville where flows have been zero during many years.

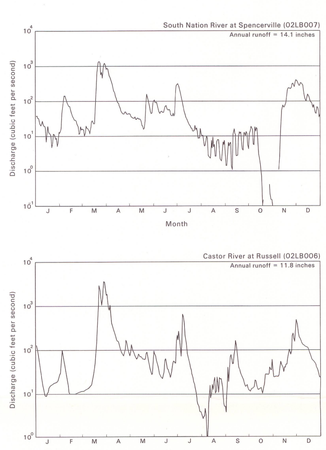
DAILY HYDROGRAPHS

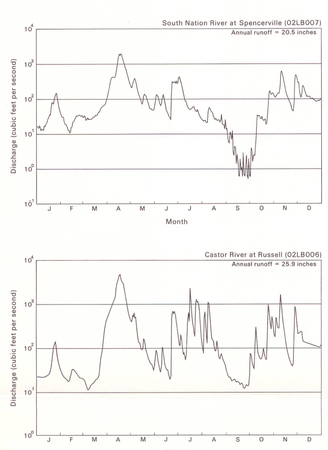


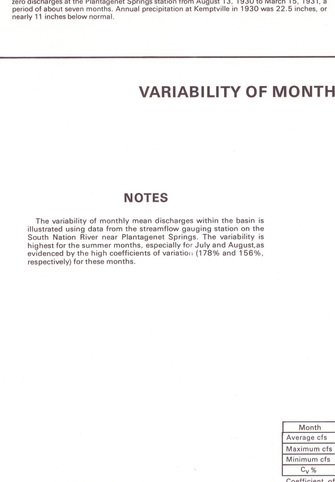


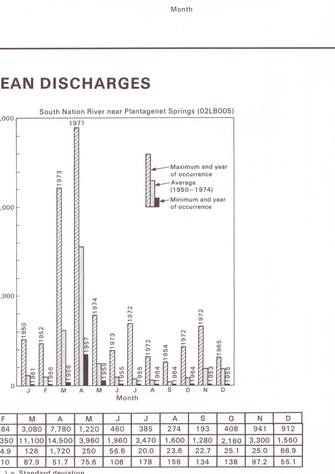


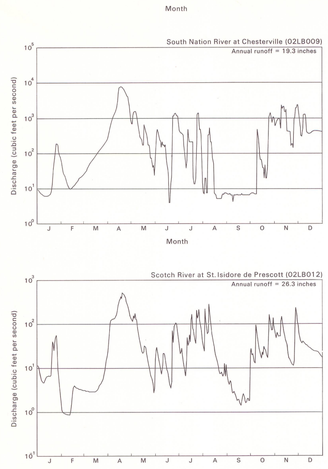












NOTES

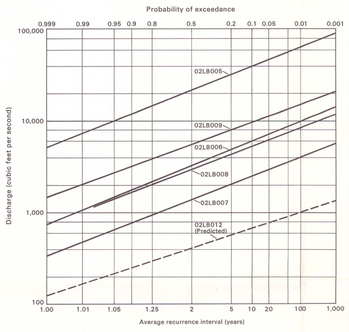
The daily variations of streamflows for years of below average (1964), average (1968), and above average (1972) annual runoff are illustrated for stations on the South Nation River near Plantagenet Springs (02LB005) and at Spencerville (02LB007). Records are not available for each of these three years for the other recording stations; daily hydrographs for the Castor River at Russell (02LB006) are available only for 1968 and 1972, and for the South Nation River at Chesterville (02LB009) and the Scotch River at St. Isidore de Prescott (02LB012) only for 1972.

Annual runoff out of the basin during these three years, as recorded at the Plantagenet Springs station, was 6.5 inches (1964), 11.6 inches (1968), and 23.0 inches (1972). Corresponding annual precipitation, as recorded at Kemptville, was 26.0 inches, 35.6 inches, and 47.7 inches, respectively.

In comparing the hydrographs for all three years, the most obvious differences for the stations near Plantagenet Springs and at Spencerville are the relatively fewer and smaller runoff events during the summer and fall of 1964 than in 1968 or in 1972. Extremely low flows (less than 1 cfs) persisted at Spencerville for approximately three months in 1964 (August, September and October). During the same period, discharges averaged less than 25 cfs at Plantagenet Springs*, as compared to discharges of 110 cfs and 2,000 cfs at this station for corresponding months in 1968 and 1974.

*Streamflow records for the period 1915 to 1932 that have recently become available, indicate zero discharges at the Plantagenet Springs station from August 13, 1930 to March 15, 1931, a period of about seven months. Annual precipitation at Kemptville in 1930 was 22.5 inches, or nearly 11 inches below normal.

ANNUAL MAXIMUM DAILY DISCHARGES

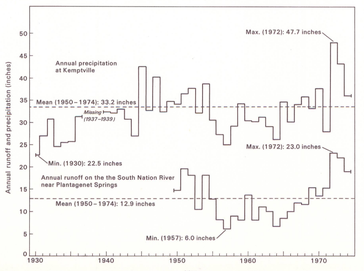


NOTES

Frequency curves of annual maximum daily discharges (after Druce, 1971) show the average recurrence intervals for specified discharges. Druce has suggested that the frequency curves for other watersheds in the basin may be computed from the area of the watershed and the length of the river.

Low streambed gradients and small channel capacities are in part responsible for major flooding upstream of Chesterville and Plantagenet. Natural stream channel capacity above Chesterville is 600 cfs (Kostuch, 1973) and 8,000 cfs above Plantagenet (Acres, 1965). The annual maximum daily discharges occur during spring freshets, with resulting flooding at these two locations. Spring floods covering up to 16,000 acres and 18,000 acres of land have been reported in these two areas. In addition, there are frequent occurrences of summer floods.

ANNUAL RUNOFF AND PRECIPITATION


Max. (1972): 47.7 inches
Annual precipitation at Kemptville
Mean (1950 – 1974): 33.2 inches
Missing (1937–1939)
Max. (1972): 23.0 inches
Min. (1930): 22.5 inches
Annual runoff on the the South Nation River near Plantagenet Springs
Mean (1950 – 1974): 12.9 inches
Min. (1957): 6.0 inches
Annual runoff and precipitation (inches)
Year

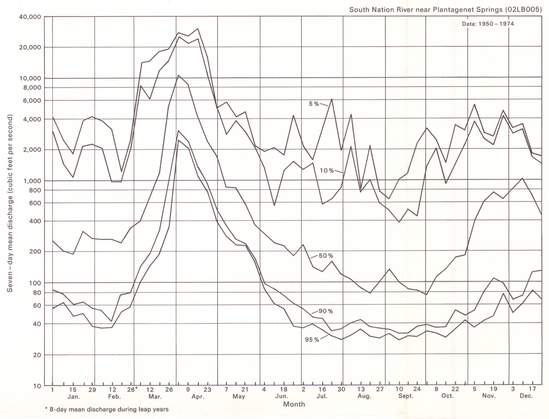
NOTES

Mean annual runoff out of the basin, as recorded at the gauging station on the South Nation River near Plantagenet Springs (02LB005), amounted to 12.9 inches (1,390 cfs) for the period 1950-1974 and is considered representative of the long-term average value. Mean annual precipitation in the basin, as represented by the data at Kemptville for this same period, was 33.2 inches.

The period since 1968 represents a period of above normal runoff, with the mean annual runoff in the period 1968-1974 near Plantagenet Springs amounting to 17.0 inches, or about 4 inches above normal.

Except for gauging stations near Plantagenet Springs and at Spencerville (02LB007), continuous data for other stations in the basin are not available until after 1968; data at other stations, therefore, do not adequately represent long-term fluctuations in runoff.

7-DAY MEAN DISCHARGES OUT OF BASIN



* 8-day mean discharge during leap years

NOTES

The above curves show the 7-day mean discharges for the South Nation River near Plantagenet Springs (02LB005) and illustrate the likely flows during each week of the year. The lowest 7-day mean discharges occur during the weeks from mid-July to about mid-October and equal or exceed 30 cfs about 95% of the time (about 1 in 20 years). Although flows from mid-October to the end of November are greater than summer flows, the difference is not significant. The highest 7-day mean discharge for this period occurs in the last week of November and equals or exceeds 80 cfs about 95% of the time.

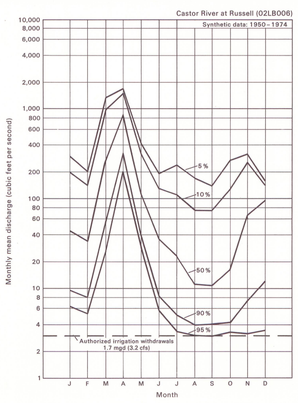
Flows during the last week in March to the end of April are usually highest; the lowest 7-day mean discharge for this period is 400 cfs, and the highest is 2,500 cfs. Both are equalled or exceeded 95% of the time.

In terms of the waste assimilative capacity of the river, the 30 cfs (16 mgd) of flow available during the summer months is small. For example, if a streamflow to effluent ratio of 10 to 1 were required by a community for the discharge of its treated waste waters, the 30 cfs flow would provide dilution for a waste water discharge of about 1.6 mgd. This discharge might be expected from a small community of about 11,000 persons.

For economic reasons, communities with waste treatment facilities use conventional waste stabilization lagoons for treatment of municipal waste waters. Because of low summer flows throughout much of the basin, treated waste water are not discharged continuously but only in the fall and spring when flows are higher.

The waste assimilative capacity of streams is considered a limiting factor for the future growth of most communities in the basin. Streamflows in the fall are not much greater than flows in the summer, and as communities in the basin grow, it is likely that discharges of treated waste waters will have to be confined to spring periods when flows are highest.

MONTHLY MEAN DISCHARGES AND WATER USE ON THE CASTOR RIVER



NOTES

Surface waters are important sources of water supplies for crop irrigation in the Castor River basin (Sheet 8, Summary of Major Water Uses). Authorized withdrawals for irrigation from streams in this basin amounted to 1.7 million gallons per day in 1975.

Streamflows in the Castor River can generally supply these major withdrawals most of the time; however, during some years flows may be insufficient to meet these demands. From the above curves, it is estimated that about 5% of the time the monthly mean discharges would be less than the needs (1.7 mgd). These shortages would most likely occur in August and September.

The continuous streamflow record for the Castor River near Russell (02LB006) is relatively short, beginning only in 1968. This record when compared with the longer streamflow record (1950-1974) for the South Nation River near Plantagenet Springs (02LB005) indicates that the 1968 to 1974 period is representative of above normal streamflow conditions. To obtain representative long-term flows for the Castor River shown in the above curves, the 1968-1974 records for the Castor River were adjusted to yield data for the 1950-1974 period using streamflows in the South Nation River near Plantagenet Springs.

VARIABILITY OF MONTHLY MEAN DISCHARGES

Month	J	F	M	A	M	J	J	A	S	O	N	D
Average cfs	585	484	3,080	7,780	1,220	460	385	274	193	408	941	912
Maximum cfs	2,570	2,350	11,100	14,500	3,960	1,960	3,470	1,600	1,280	2,160	3,300	1,560
Minimum cfs	494	44.9	126	1,720	250	56.6	20.0	23.6	22.7	25.1	25.0	66.9
C_v %	115	110	87.9	51.7	75.6	108	178	156	134	138	97.2	55.1

Coefficient of variation (C_v) = Standard deviation / Mean

NOTES

The variability of monthly mean discharges within the basin is illustrated using data from the streamflow gauging station on the South Nation River near Plantagenet Springs. The variability is highest for the summer months, especially for July and August, as evidenced by the high coefficients of variation (178% and 156%, respectively) for these months.

METRIC CONVERSION FACTORS

1 inch	=	2.540 centimetres
1 mile	=	1.609 kilometres
1 square mile	=	2.590 square kilometres
1 cubic foot per second	=	0.02832 cubic metres per second
1 cubic foot per second per square mile	=	0.01093 cubic metres per second per square kilometre
1 million gallons per day	=	4.546 million litres per day

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Cartography by D. Griffin and D. Bonner.

Base maps derived from 1:50,000 sheets of the National Topographic series.

Ontario

MINISTRY OF THE ENVIRONMENT

Water Resources Branch
Hydrology and Monitoring Section

WATER RESOURCES REPORT 13

WATER RESOURCES OF THE SOUTH NATION RIVER BASIN

Sheet 6

SURFACE–WATER HYDROLOGY